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(54) **Method for Injection Molding Articles of Thermoplastic Material and Mold for Carrying Out Said Method**

(57) A method is proposed for producing injection molded articles 10 of thermoplastic material whose walls 13, 14 enclose a hollow space 15, wherein a mold cavity 23 with an initially reduced volume of a mold 20 is first injected full of the plastic melt 31, then its volume is enlarged and it is subjected to a fluidic pressure medium so that the plastic melt 31 distributes along and contacts the walls of the enlarged mold cavity volume while forming a hollow space.

So that the desired or required hollow spaces 15 in the molded articles 10 can be formed with exact reproducibility, the fluidic pressure medium is injected into the plastic melt 31 that completely fills the initially reduced mold cavity volume – if desired after a quiescent or rest period following the plastic injection process – and the volume of the mold cavity 23 is selectively enlarged only during or in conjunction with said injection and/or as a function of this injection of the fluidic pressure medium into the plastic melt 31.

## Method for Injection Molding Articles of Thermoplastic Material and Mold for Carrying out said Method

The invention concerns a method for injection molding articles of thermoplastic material whose walls enclose a hollow space, wherein a cavity with an initially reduced volume of a mold is first injected full of the plastic melt, then its volume is enlarged and it is subjected to a fluidic pressure medium (gas) so that the plastic melt distributes along and contacts the walls of the enlarged mold cavity volume while forming a hollow space.

The invention also relates to a mold for carrying out this method wherein the fluidic pressure medium can be introduced into the mold cavity after injection of the plastic melt and wherein the mold cavity has a section that can only be unblocked to accommodate plastic melt at certain times.

A method of the generic type and a mold for carrying it out are already known, as is clear from US-A-5,028,377, for example.

According to this prior art, first the mold cavity is filled completely with the plastic melt. Then an increase in the initially reduced volume of the mold cavity is accomplished, and the plastic melt is subsequently subjected to a fluidic pressure medium, in particular a gas, so that it distributes along and contacts the walls of the enlarged mold cavity volume while forming a hollow space in its interior, producing the exact contour of the molded article.

This method of manufacturing injection molded articles of thermoplastic material is always used when the volume shrinkage of the plastic melt injected into a mold cavity is not by itself sufficient to allow the formation of the desired, or even required, hollow

space within the molded article in question by injection of the fluidic pressure medium (gas).

However, this method of manufacture is also used to produce injection molded articles from plastic material when it is necessary to ensure that the fluidic pressure medium injected to form the hollow space does not penetrate thin-walled regions of the molded article in an undesirable manner; consequently a certain degree of cooling of the plastic melt is needed before injection of the fluidic medium starts. Only the possibility of a later expansion of the volume of the mold cavity ensures that satisfactory formation of the hollow space in the molded part can be achieved by injection of the fluidic pressure medium in this case.

All applications of the method disclosed by US-A-5,028,377 suffer a significant problem, however. As a result of the volume enlargement following injection of plastic melt to fill the mold cavity of initially reduced volume, a pressure drop inevitably occurs in this plastic melt before the fluidic pressure medium begins to act thereon. This pressure drop proves to be extremely undesirable in practice, however, because it impedes or prevents reproducible formation of the hollow spaces in the molded articles in question.

The object of the invention is to specify a method of the generic type and also a mold for carrying out said method that, essentially without significant added technical effort, ensures the production of molded articles from thermoplastic material wherein the desired or required hollow spaces can be formed with exact reproducibility.

The object with regard to the method is achieved in accordance with the invention in that the fluidic pressure medium (gas) is injected into the plastic melt that

completely fills the initially reduced mold cavity volume, and in that the volume of the mold cavity is selectively enlarged only during or in conjunction with the injection and/or as a function of the injection of the fluidic pressure medium into the plastic melt.

It has proven especially useful in accordance with the invention for the fluidic pressure medium (gas) to be injected into the plastic melt that completely fills the initially reduced mold cavity volume only after a quiescent or rest period following the plastic injection process.

It is moreover advantageous in accordance with the invention that, during the quiescent or rest period that takes place between the end of the plastic melt injection and the start of injection of the fluidic pressure medium, not only is the injection pressure produced by the injection unit maintained, but an additional holding pressure can also be applied to the reduced mold cavity volume or the plastic melt located therein, and also that the fluidic medium can be applied to the reduced mold cavity volume or the plastic melt located therein before the working pressure produced by the injection unit drops off.

However, as mentioned above, selective enlargement of the volume of the cavity in the mold need not always take place only after a quiescent or rest period. Rather, it can if desired also take place in a precisely controlled or regulated manner, for example in a pressure-dependent, path-dependent and/or time-dependent way. Pressure-dependent control or regulation in this context can be achieved by measurement of the melt pressure or hydraulic pressure present in or at the plasticator, or by measurement of the melt pressure in the mold, wherein in the latter case the measurement should take place at a point where enlargement of the mold cavity volume starts.

Path-dependent control or regulation of volume enlargement of the mold cavity can be achieved as a function of the screw position in the plasticator, while the start of melt injection into the mold cavity can be used for time-dependent control or regulation. It is possible in this way to start volume enlargement only at a certain compression of the melt in the mold cavity.

An important process refinement in accordance with the invention, however, is that the pressure level of the fluidic medium during volume enlargement of the mold cavity is controlled and/or regulated and thus can be optimally adapted to the applicable requirements. During this time the fluidic medium is available in practically unlimited quantities and in the normal case is always held at the same pressure level by the control or regulation. It is also conceivable, however, to execute a predefinable pressure profile that includes, for example, a rising and falling pressure curve.

A generic mold for carrying out the method disclosed above, wherein the mold cavity has a section that is unblocked to accommodate plastic melt only at certain times, can on the one hand be constructed in accordance with the invention such that the section is formed in the mold cavity itself and its dimensions are determined by filler pieces movable therein.

Alternatively, however, it is also possible in such a mold for the section to be located in a region adjacent to the actual mold cavity and to adjoin the latter through an overflow that can be blocked or unblocked as desired.

In the first case, in turn, it is possible either for the section to be defined by a core slide that projects into the mold cavity, or for the section to be located in at least one zone of the mold cavity which can be unblocked by a movable filler piece matched to its

cross-section. Alternatively, in the second case the overflow can be blocked and unblocked by a mechanical actuator, such as a slide.

In any case, it is advantageous in accordance with the invention if the filler pieces for the section and/or the actuators for the overflow are operable by external control and/or by pressure control and/or by time control, because this allows the mold to be adjusted easily to a wide variety of requirements.

External control can be accomplished by pneumatic and/or hydraulic cylinder, but also by electrical drive such as solenoids, spindle motors or the like, for both the forward and reverse motion of the filler pieces or actuators.

Motion control for the filler pieces or actuators can also be accomplished as a function of the pressure of the plastic melt and/or the fluidic medium, however. In this context, it is possible on the one hand to use the pressure in the plastic melt or the fluidic medium to trigger the external control. On the other hand, the plastic melt or the fluidic medium can also be used to act directly on the filler pieces that affect the section in the mold cavity if said filler pieces determine the initially reduced mold cavity volume through energy storing devices such as spring pressure. When a certain melt pressure is reached at the slide that is loaded by the energy storage device, said slide is forced back out of the position defining the initially reduced mold cavity volume and thus automatically produces the intended enlargement of the mold cavity volume.

Automatic pressure control of the last type mentioned can also work in combination with an external control mechanism, for example in such a manner that volume enlargement of the mold cavity takes place solely against the energy storage device as a function of melt pressure, and hence automatically, while the return to the

initially reduced mold cavity volume is at least assisted by (pneumatic, hydraulic or electric) external control.

When molds are used wherein enlargement of the mold cavity volume is accomplished by the means that the section is located in a region adjacent to the actual mold cavity and adjoins the latter through an overflow that can be blocked or unblocked as desired, there exists the advantageous possibility to use this auxiliary cavity itself as an additional mold cavity. Auxiliary molded articles can then be produced simultaneously in this additional mold cavity using the excess melt arising during the production of the primary molded articles. This possibility is advantageous especially when the quality requirements for the auxiliary molded parts are not particularly stringent.

The invention is described in detail below using example embodiments. The drawings show:

Fig. 1 a longitudinal section of a pot-shaped injection molded article of plastic material with a hollow space enclosed in its bottom wall and also in its side wall,

Fig. 2 a longitudinal section of an injection mold suitable for producing the injection molded article from Fig. 1 that has the sprue of the mold cavity resting against the nozzle end of an injection unit prior to the start of an injection molding process.

Fig. 3 the injection mold after performance of the first phase of an injection molding process for the molded article, in a section as in Fig. 2,

Fig. 4 the injection mold after completion of the final phase of the injection molding process for producing the molded article,

Fig. 5 a flow diagram of the steps of the injection molding process according to the invention,

Fig. 6 a longitudinal section through another embodiment or design of an injection mold after performance of the first phase of the injection molding process for the molded article,

Fig. 7 the injection mold from Fig. 6 at the end of the injection molding process,

Fig. 8 yet another design or embodiment of an injection mold in longitudinal section after performance of the first phase of the injection molding process for the molded article,

Fig. 9 the injection mold from Fig. 8 at the end of the injection molding process for producing the molded article, and

Figs. 10 and 11

each show longitudinal sections of two additional designs or embodiments of an injection mold in longitudinal section after performance of the first phase of an injection molding process for the molded article.

Fig. 1 of the drawing shows a pot-shaped molded article 10 made of an injection-moldable plastic, having a bottom region 11 and a side region 12 that adjoins thereto as a single piece. The bottom region 11 and the side region 12 of the molded article enclose a hollow space 15 between an outer wall 13 and an inner wall 14, as can easily be seen from Fig. 1 of the drawings.

Since the entire molded article 10 is produced by injection molding of a thermoplastic material in an injection mold, Fig. 1 of the drawing also shows, with dashed lines, the sprue 16 that is necessarily produced during injection molding and is cut off after ejection from the injection mold.

Figs. 2 through 4 of the drawings show an injection mold 20 for producing the molded article 10 from Fig. 1 in a preferred embodiment and design. It has two mold halves 21 and 22 that are moved together to define a mold cavity 23, and in the process interlock at least partially. To open the mold cavity 23, in contrast, the two mold halves 21 and 22 are moved apart.

Figs. 2 through 4 each show the injection mold 20 in its closed state wherein the two mold halves 21 and 22 rest against one another and interlock. The mold half 21 is connected by a sprue bushing 24 to a gate 25 at the nozzle end of an injection unit or extruder 26.

The second mold half 22 of the injection mold 20 is equipped with a so-called core slide 27, which can be advanced at least partway into the mold cavity 23 and can also be withdrawn therefrom. For this purpose, an actuator 28 can be used, which sits on the mold half 28 and in the example embodiment shown comprises a piston/cylinder unit that can be actuated hydraulically or pneumatically. However, a spindle motor or a solenoid that engages with the core slide 27 may also be used equally well as the actuator 28.

As can be seen in Figs. 2 and 3, the core slide 27 is advanced a predetermined distance 29 into the mold cavity 23 with the aid of the actuator 28 at the start of each injection molding process. Said cavity is initially reduced by this means to a volume

(Fig. 2) that is smaller than the total volume of the molded article 10 to be produced herein through injection molding.

While thermoplastic melt can be fed from the injection unit or extruder 26 into the mold cavity 23 through the gate 25 of the sprue bushing 24, at least one, preferably several, injection units 30 are associated with the injection mold 20, for example also at its mold half 21, through which a fluidic pressure medium, for example liquid or gas, can be fed into the mold cavity 23 in addition to the thermoplastic melt 31.

Fig. 5 of the drawings shows a flow diagram of the steps of an injection molding process that can be used to produce the molded article 10 in Fig. 1 in an injection mold 20 shown in Figs. 2 - 4.

At the beginning of each individual injection molding process or cycle, the injection mold 20 is in the state shown in Fig. 2. The volume of the mold cavity 23 is initially reduced by the core slide 27 that has been advanced the predetermined distance 29 by the actuator 28. This initially reduced volume of the mold cavity 23 is then injected full or filled as in Fig. 3 with the thermoplastic melt 31 as is shown schematically in Fig. 5 by block 1. The filling or full injection of the mold cavity 23 with plastic melt 31 can be followed by a rest or quiescent period as is indicated in Fig. 5 by the dashed box 2. During this rest or quiescent period 2, a so-called holding pressure, which is indicated in Fig. 3 by the directional arrow, can be exerted on the plastic melt 31 in the mold cavity 23, for example by the injection unit or extruder 26. Thus, during the rest or quiescent period 2, it is not only possible to maintain the melt pressure produced by the injection unit or extruder 26 in the plastic melt contained in the reduced volume of the mold cavity 23, but also to expose it to a holding pressure exceeding the

normal melt pressure. This has the result that the melt layers next to the walls of mold cavity 23 are pressed tightly against the mold walls and consequently are formed exactly, even though the zones of plastic melt a distance away from the mold walls are still molten.

After the rest or quiescent period 2, if applicable, has elapsed, the fluidic pressure medium is brought into action in the thermoplastic melt 31 contained in the reduced volume of the mold cavity 23 through the injection units 30, said medium having a pressure level that corresponds at least to the melt pressure present in the mold cavity 23 after the end of the injection process 1.

Only after the fluidic pressure medium has been applied to the mold cavity 23 of the injection mold 20 as shown in block 3 of Fig. 5 is the initially reduced volume of the mold cavity 23 selectively enlarged (cf. Figs. 3 and 4) by means of the actuator 28, as indicated by block 4 of Fig 5. During or in conjunction with the selective volume enlargement of the mold cavity 23, an injection of the fluidic pressure medium takes place in such an amount that a molded article 10 is produced in which a hollow space 15 is formed whose volume corresponds at least to the volume by which the mold cavity 23 has been increased by withdrawing the core slide 27 by the predetermined distance 29.

During the enlargement of the mold cavity 23 from its initially reduced volume (cf. Figs. 2 and 3) to the maximum volume (cf. Fig. 4) as indicated by the box 4 in Fig. 5, it is important that the pressure level of the fluidic medium (liquid or gas) supplied through the injection units 30 remains continuously under pressure control or regulation, as is indicated by block 5 in Fig. 5. Furthermore, it is especially important in this context that the fluidic pressure medium does not act into the mold cavity 23 with a volume-limited

amount, but instead is available in essentially unlimited volume, so that simple pressure control or regulation of the fluidic pressure medium can be used at essentially all times.

Once the molded article 10 is adequately hardened inside the injection mold 20 as shown in Fig. 4, the fluidic pressure medium is removed from the hollow space 15 formed in the molded article 10, for example via the injection units 30, as is indicated by block 6 in Fig. 5. The injection mold can then be opened by separating its two mold halves 21 and 22, and the molded article 10 can finally be ejected from the injection mold 23, as is indicated by block 7 in Fig. 5.

The injection molding from thermoplastic material of molded articles 10 that enclose a hollow space 15 with their walls 13 and 14 is described above using Figs. 1-5. In this production method, a mold cavity 23 of the injection mold 20, whose volume is initially reduced as shown in Figs. 2 and 3, is injected full of plastic melt 31 (Fig. 3) and then has its volume enlarged (Fig. 4) and is also subjected to a fluidic pressure medium (gas or liquid) so that the plastic melt 31 distributes along the walls of the enlarged mold cavity volume and contacts them while forming a hollow space 15.

It is particularly important here that

- the fluidic pressure medium (gas or liquid) is injected into the plastic melt 31 that completely fills the initially reduced mold cavity volume, if desired after a rest or quiescent period that follows the plastic injection process, and that

- the volume enlargement of the mold cavity selectively takes place or is performed only during or in conjunction with the injection and/or as a function of the injection of this fluidic pressure medium into the plastic melt.

Since the motion of the core slide 27 that serves to enlarge the volume of the mold cavity 23 is accomplished by an actuator 28 in the example embodiment of an injection mold 20 shown in Figs. 2 - 4, the injection mold 20 can operate in a variety of ways. Thus, the actuator 28 for the core slide 27 can be triggered by external control that is activated only after filling of the mold cavity 23 with thermoplastic melt and/or after the fluidic pressure medium begins to act on this plastic melt 31. However, the trigger for the actuator 28 can also be a specific melt pressure in the mold cavity 23 or the application of the fluidic pressure medium to the plastic melt 31 contained in the mold cavity 23. In addition to an externally controlled component and a pressure-controlled component, a time-controlled component can also be integrated in the injection mold 20 for the volume enlargement of the mold cavity 23. In any case, however, it must be ensured that a volume enlargement of the volume-reduced mold cavity 23 injected full of thermoplastic melt 31 cannot ever take place until after the action of the fluidic pressure medium on this plastic melt 31 has already begun.

Whereas, in the injection mold as shown in Figs. 2-4, the mold cavity 23 functions together with a core slide 27 that need only be withdrawn within the actual mold cavity 23 in order to unblock additional areas therein for the molded article 10 that is to be formed, Figs. 6 and 7 show a design for an injection mold 20 with a mold cavity 23 that corresponds to the entire outside contour of the molded part 10 that is to be produced therein, but wherein a part of this outside contour is at times completely filled by a core slide 27 that can be laterally advanced and withdrawn. Here, too, the core slide 27 is moved by an externally controllable actuator 28.

Figs. 8 and 9 show an injection mold 20 that has the same basic design as the injection mold in Figs. 6 and 7.

However, here the actuator 28 for the core slide 27 is replaced by a load spring 33 that serves to hold the core slide 27 in its blocking position as in Fig. 8. The force of the load spring 33 here is set such that it holds the core slide 27 in its blocking position as in Fig. 8 until a specific internal pressure in the mold cavity 23 is exceeded.

This pressure exceedance can be produced by the fluidic pressure medium supplied through the injection units 30 into the mold cavity 23 and the thermoplastic melt 31 located therein. The action of the pressure increase on the angled surface 34 of the core slide 27 creates a force component that raises the core slide 27 against the action of the load spring 33 and thus displaces it from the previously blocked region of the mold cavity 23, as is shown in Fig. 9. By this means, the thermoplastic melt is pressed against all of the inside walls of the entire mold cavity 23, thus forming the molded article 10 with the hollow space 15.

Additional injection molds 20 can be seen in Figs. 10 and 11 wherein the entire volume of the mold cavity 23 required for the formation of a molded article 10 is always available or is available from the beginning.

However, so as to make it possible to form a molded article 10 that has a hollow space 15 by injecting fluidic pressure medium through the injection units 30 into the plastic melt 31 that fills the mold cavity 23, special additional measures are taken here. These additional measures are that the actual mold cavity 23 adjoins, via an overflow channel 35, an auxiliary chamber 38 into which the excess thermoplastic melt can be displaced. In this regard, the overflow 35 is normally blocked off from the mold cavity 23

by a mechanical actuator, for example a slide 37. However, as soon as the fluidic pressure medium delivered through the injection units 30 begins to act on the plastic melt filling the actual mold cavity 23, the slide 37 can be unblocked to open the overflow 35 so that the excess plastic melt 31 can then move into the auxiliary chamber 36. In this context, the slide 37 in Fig. 10 can be actuated by external control, for example by an actuator 38, while in Fig. 11 it can be actuated by pressure control, for example in that it is pushed into the open position against the action of a load spring 39.

It is also important in the example embodiments in Figs. 10 and 11 that the fluidic pressure medium in the mold cavity 23 begins to act on the plastic melt 31 before the overflow 35 to the auxiliary chamber 36 is opened.

Finally, it should once again be noted that in all of the aforementioned cases there exists the possibility to operate an automatic pressure control in combination with an external control, for example in such a way that either a volume enlargement of the mold cavity itself or an overflow therefrom is accomplished by melt pressure solely against the action of an energy storage device and thus automatically, while the return to the initially reduced mold cavity volume or the blocking of the overflow can at least be assisted by external pneumatic, hydraulic or electric control.

Lastly, it is worth taking notice of an advantageous possibility for using the injection mold 20 from Figs. 10 and 11. Specifically, it is conceivable with such an injection mold 20 for the auxiliary chamber 36 that adjoins the actual mold cavity 23 to itself be used as an additional mold cavity. In this case, the excess plastic melt from the production of the molded article 10 can produce molded plastic articles in the auxiliary

chamber 36 which now acts as a mold cavity, especially articles whose practical use is not subject to particularly high quality requirements.

## List of Reference Numbers

| | |
|---|---|
| 1 | Process step = Injecting the initially reduced mold cavity full of plastic melt |
| 2 | Process step = Rest or quiescent period for the plastic melt located in the mold cavity and/or application of holding pressure to the plastic melt located in the mold cavity |
| 3 | Process step = Applying action of fluidic medium to plastic melt in initially reduced mold cavity |
| 4 | Process step = Enlarging mold cavity to maximum volume |
| 5 | Process step = Pressure control or regulation of the fluidic pressure medium available independent of quantity |
| 6 | Process step = Removing fluidic pressure medium from the hollow space of the molded article |
| 7 | Process step = Ejecting the finished molded article from the mold cavity |
| 10 | Molded article |
| 11 | Bottom region |
| 12 | Side region |
| 13 | Wall |
| 14 | Wall |
| 15 | Hollow space |
| 16 | Sprue |
| 20 | Injection mold |
| 21 | Mold half |
| 22 | Mold half |

| | |
|---|---|
| 23 | Mold cavity |
| 24 | Sprue bushing |
| 25 | Gate |
| 26 | Injection unit/extruder |
| 27 | Core slide |
| 28 | Actuator |
| 29 | Predetermined distance |
| 30 | Injection unit |
| 31 | Thermoplastic melt |
| 32 | Directional arrow |
| 33 | Load spring |
| 34 | Angled surface |
| 35 | Overflow channel |
| 36 | Auxiliary chamber |
| 37 | Slide |
| 38 | Actuator |
| 39 | Load spring |

## Claims

1. Method for injection molding of molded articles (10) of thermoplastic material whose walls (13, 14) enclose a hollow space (15), wherein a cavity (23) with an initially reduced volume (27) of a mold (20; 21, 22) is first injected full of the plastic melt (31), then its volume is increased (27, 28) and it is subjected (30) to a fluidic pressure medium (gas) so that the plastic melt (31) distributes along and contacts the walls of the enlarged mold cavity volume (23) while forming a hollow space (15), **characterized in that**,
   - only after a quiescent or rest period following the plastic injection process is the fluidic pressure medium (gas) injected (30) into the plastic melt (31) that completely fills the initially reduced (27) mold cavity volume (23),
   - and in that, in turn, only during or in conjunction with the injection (30) and/or as a function of this injection (30) of the fluidic pressure medium into the plastic melt (31) is the volume of the mold cavity (23) selectively enlarged (28).

2. Method from claim 1, **characterized in that** the fluidic pressure medium (gas) is injected (30) into the plastic melt (31) that completely fills the initially reduced (27) mold cavity volume (23) only after a quiescent or rest period following the plastic injection process.

3. Method from claim 2, **characterized in that**, during the quiescent or rest period that takes place between the end of plastic melt injection and the start of injection

of the fluidic pressure medium, an additional holding pressure is applied to the reduced mold cavity volume (23) or the plastic melt (31) located therein, and in that that the fluidic medium is also applied to the reduced mold cavity volume.

4. Mold for carrying out the method from one of claims 1 – 3, wherein the fluidic pressure medium can be introduced into the mold cavity after injection of the thermoplastic melt and wherein the mold cavity has a section that can only be unblocked to accommodate plastic melt at certain times, **characterized in that** the section that can only be unblocked at certain times (29) is blocked by a load spring (33) and/or can be unblocked against the action of a load spring (39).

5. Mold for carrying out the method from one of claims 1 – 4, wherein the fluidic pressure medium can be introduced into the mold cavity after injection of the thermoplastic melt and wherein the mold cavity has a section that can only be unblocked to accommodate plastic melt at certain times, **characterized in that** the section that can only be unblocked at certain times (29) is formed in the mold cavity (23) itself and its dimensions are determined by filler pieces (27) movable therein (Figs. 2 - 4).

6. Mold from claim 5, **characterized in that** the section that can only be unblocked at certain times (29) is defined by a core slide (27) projecting into the mold cavity (23).

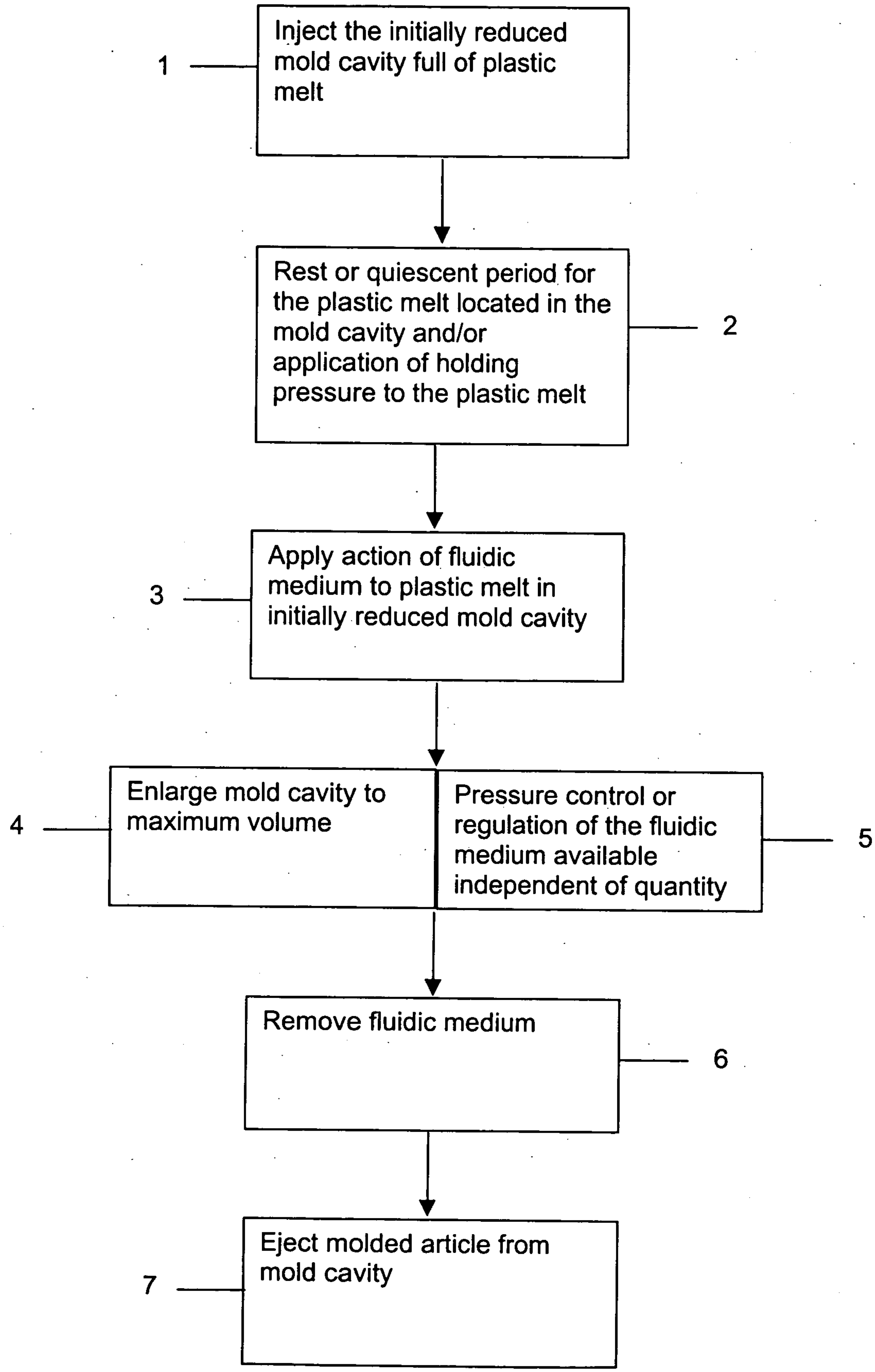
7. Mold from claim 5, **characterized in that** the section that can only be unblocked at certain times (29) is located in at least one zone of the mold cavity (23), which can be unblocked by a movable filler piece matched to its cross-section (Figs. 6 and 7, or 8 and 9).

8. Mold from claim 5, **characterized in that** the section (36) is located in a region adjacent to the actual mold cavity (23) and adjoins the latter through an overflow (35) that can be blocked and unblocked as desired.

9. Mold for carrying out the method from one of claims 1 – 3, wherein the fluidic pressure medium can be introduced into the mold cavity after injection of the thermoplastic melt and wherein the mold cavity has a section that can only be unblocked to accommodate plastic melt at certain times, **characterized in that** the section that can only be unblocked at certain times (29) can be unblocked by external control (28 or 38) and/or by pressure control and/or by time control.

10. Mold from one of claims 4 – 9, **characterized in that** the filler pieces (27) for the section and/or the actuators (37) for the overflow (35) are operable by external control (28 or 38) and/or by pressure control (33 or 39) and/or by time control.

Fig. 5



Inject the initially reduced mold cavity full of plastic melt
1
Rest or quiescent period for the plastic melt located in the mold cavity and/or application of holding pressure to the plastic melt
2
Apply action of fluidic medium to plastic melt in initially reduced mold cavity
3
Enlarge mold cavity to maximum volume
4
Pressure control or regulation of the fluidic medium available independent of quantity
5
Remove fluidic medium
6
Eject molded article from mold cavity
7

European Patent Office

# EUROPEAN SEARCH REPORT

Application No. EP 94 10 8506

## PERTINENT DOCUMENTS

| Category | Identification of documents, with indication of relevant parts, if necessary | Relates to Claim | CLASSIFICATION OF APPLICATION (Int.Cl.$^5$) |
|---|---|---|---|
| X<br>Y | EP-A-0 440 020 (SCHADE KG)<br>* column 6 , line 21 - line 28;<br>figures * | 1, 4-6, 9<br>8 | B29C45/17 |
| X | US-A-4 101 617 (FRIEDERICH)<br>* column 3, line 7 - line 56;<br>figures 2,3 * | 1, 4-6 | |
| X | US-A-2 331 688 (HOBSON)<br>* page 2, left column, para. 5 - para. 7; figures 1, 3 * | 1, 4-6 | |
| X<br>A | WO-A-92 07697 (DELBROUCK)<br>* entire document * | 1, 4-6<br>3 | |
| X | EP-A-0 529 080 (ASAHI KASEI KOGYO KABUSHIKI KAISHA)<br>* entire document * | 1, 4-6 | |
| X | PATENT ABSTRACTS OF JAPAN<br>vol. 15, no. 120 (M-1096) 25 March 1991<br>& JP-A-03 009 820 (ASAHI CHEM IND CO LTD)<br>* abstract * | 1, 4-6 | SUBJECT AREAS SEARCHED (Int. Cl.$^5$)<br>B29C |
| Y | GB-A-2 260 932 (HONDA GIKEN KOGYO KABUSHIKI KAISHA)<br>* page 6, para. 2 - page 10, para. 3;<br>figures 1,2 * | 8 | |
| Y | EP-A-0 438 279 (KETER PLASTIC)<br>* column 4, line 52 - column 5, line 41;<br>figures 1,2 * | 8 | |

The present search report was issued for all patent claims.

| Search location: | Search completed on: | Examiner: |
|---|---|---|
| The Hague | 16 September 1994 | J. Bollen |

CATEGORY OF DOCUMENTS CITED:

X: Of special importance when considered by itself
Y: Of special importance in connection with another publication of the same category
A: Technological background
O: Nonwritten disclosure
P: Interim literature
T: Theories or principles on which the invention is based
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